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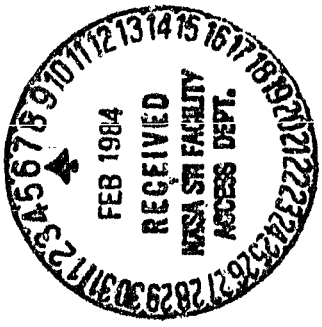
STELLAR ULTRAVIOLET ROCKET RESEARCH PROGRAM

FINAL REPORT



NASA CONTRACT NO. NGR 06-003-176

FINAL REPORT

STELLAR ULTRAVIOLET ROCKET RESEARCH PROGRAM
(NGR06-003-176)

OBJECTIVES:

The primary objective of the Stellar Ultraviolet Rocket Research Program supported by NASA NGR 06-003-176 is to determine the physical properties of weak stars and nebulae by means of rocket observations in the 900-3000Å region of the spectrum.

In order to accomplish the primary objective, it was necessary to:

(1) determine the absolute energy distribution of standard stars in the 1100 to 3400 Å region to an accuracy of ± 10%.

(2) develop rocket instrumentation capable of measuring the strength of emission lines in the 1200 to 1800 Å region of the spectrum from the hot plasma (20,000 to 200,000° K) surrounding weak stars and nebulae like the crab nebula pulsar.

The data obtained concerning the relative strength of the ultraviolet emission lines in its spectrum make it possible to determine the temperature, density and composition of the emitting material. These data would permit the discrimination between various theoretical models describing the physical nature of the nebula.

SIGNIFICANT ACCOMPLISHMENTS:

1. Ultraviolet Calibration Star Data

A ¼ meter ultraviolet spectrometer was developed to measure the ultraviolet flux from several standard type stars.

This ¼ meter spectrometer was flown successfully on Aerobee rockets 13.004 in July of 1972 and on 26.031 in February of 1974. The ultraviolet flux from αLyr, ηU Ma, ζ Oph, $\varkappa$ Ori, δ Ori, α CMa, β CMa, and α Leo were measured. These values agreed with the OAO data obtained by Code in the 1200 to 3400 Å region to ± 9%.

2. Faint Object Spectrometer Development

A faint object spectrometer was developed to observe stars and

nebula as faint as unreddened 10^m OB stars or equivalent nebula in the region of 900 to 1800 Å with a 3 Å resolution and a 3% accuracy in a 60 sec. observation.

The instrument consists of a multi-channel, photon locating, microchannel plate detector located at the focus of a Rowland circle spectrometer. The use of this 'Codacon' detector increases the sensitivity of the spectrometer by two or three magnitudes making it possible to observe the ultraviolet spectrum of weak stars during a 300 sec. rocket flight.

The detector consists of two 2.54mm x 25.5mm microchannel plates placed next to a coded-anode photon locater which counts and encodes each photon event into 1024 spectral storage bins. After a preselected integration time, the memory is then read-out producing a complete spectrum every 800 msec.

The spectrometer is located at the prime focus of a 16" f/2.5 mirror coated to give high reflectivity of ultraviolet light.

Extensive laboratory testing proved the spectrometer to be a significant advancement in sensitivity and detector technology.

Laboratory calibration spectra of a helium and argon discharge lamps are shown in figures 1 and 2. Individual lines have an intensity half-width of 1.8 pixels or 2.8 Å, suggesting that the optical performance exceeds the resolution of the detector.

FAINT OBJECT SPECTROMETER CALIBRATION SPECTRUM (HE ARC LAMP)

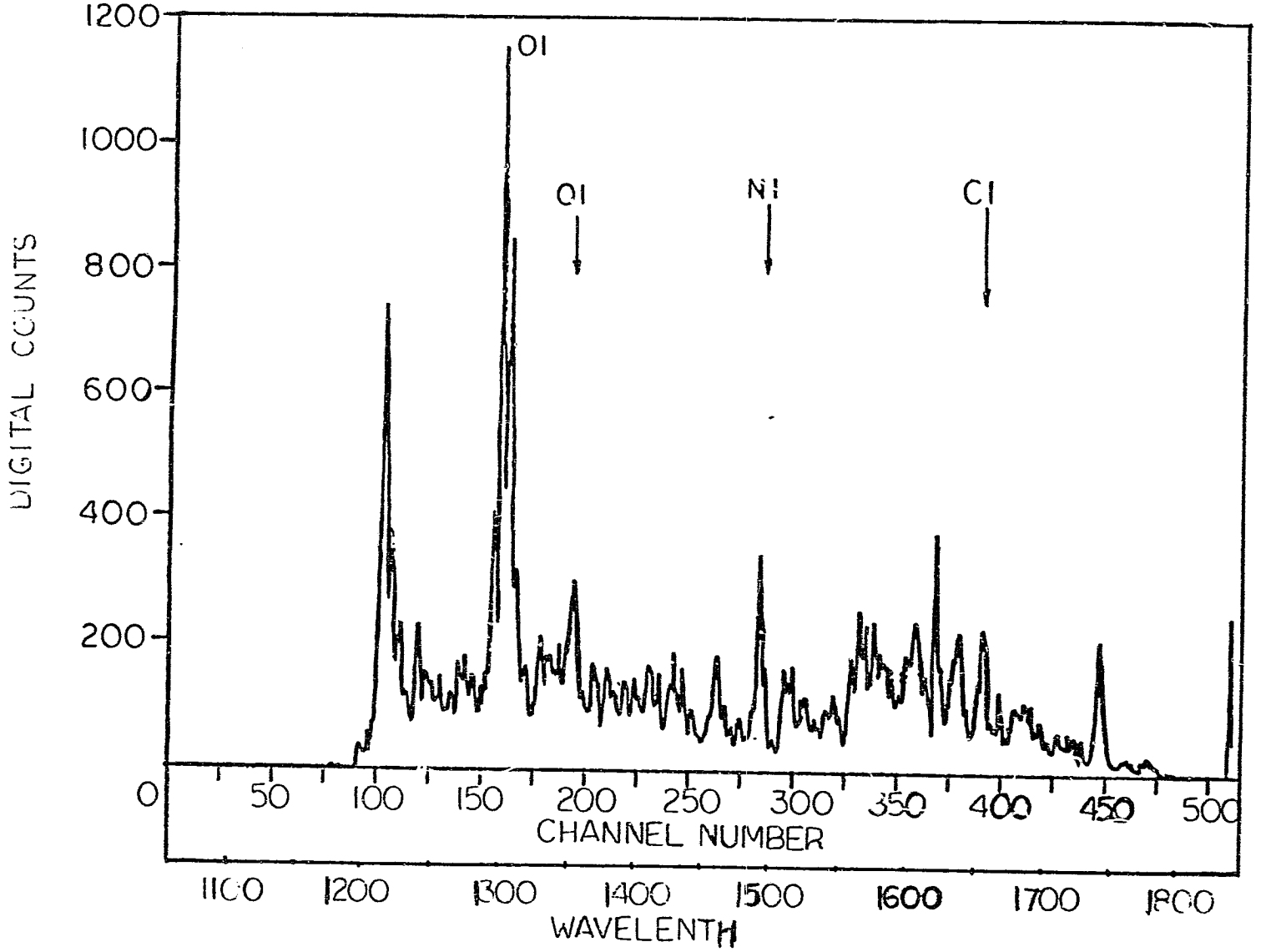


FIGURE 1

FAINT OBJECT SPECTROMETER CALIBRATION SPECTRUM (ARGON MINI-ARC)

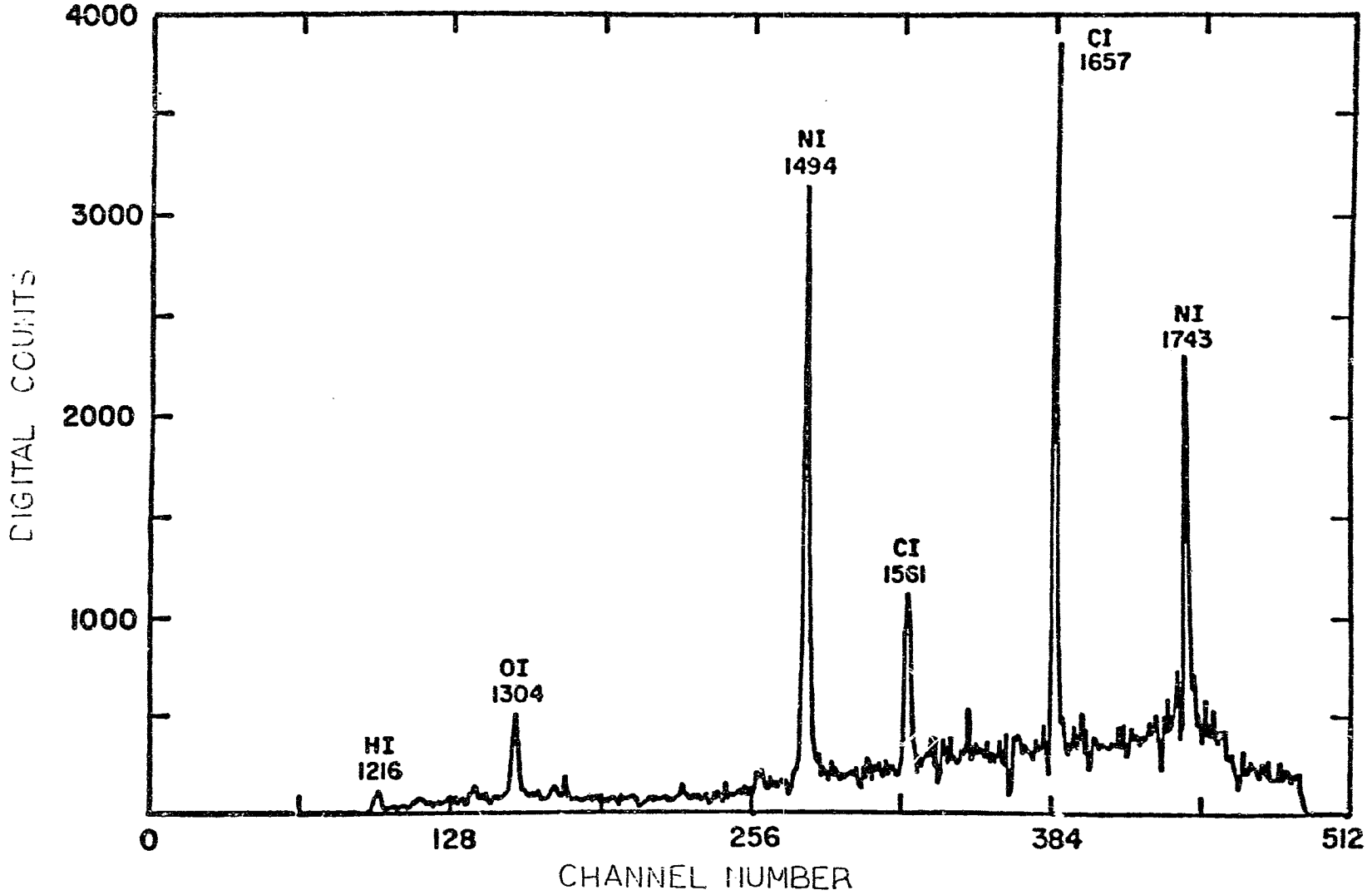


FIGURE 2

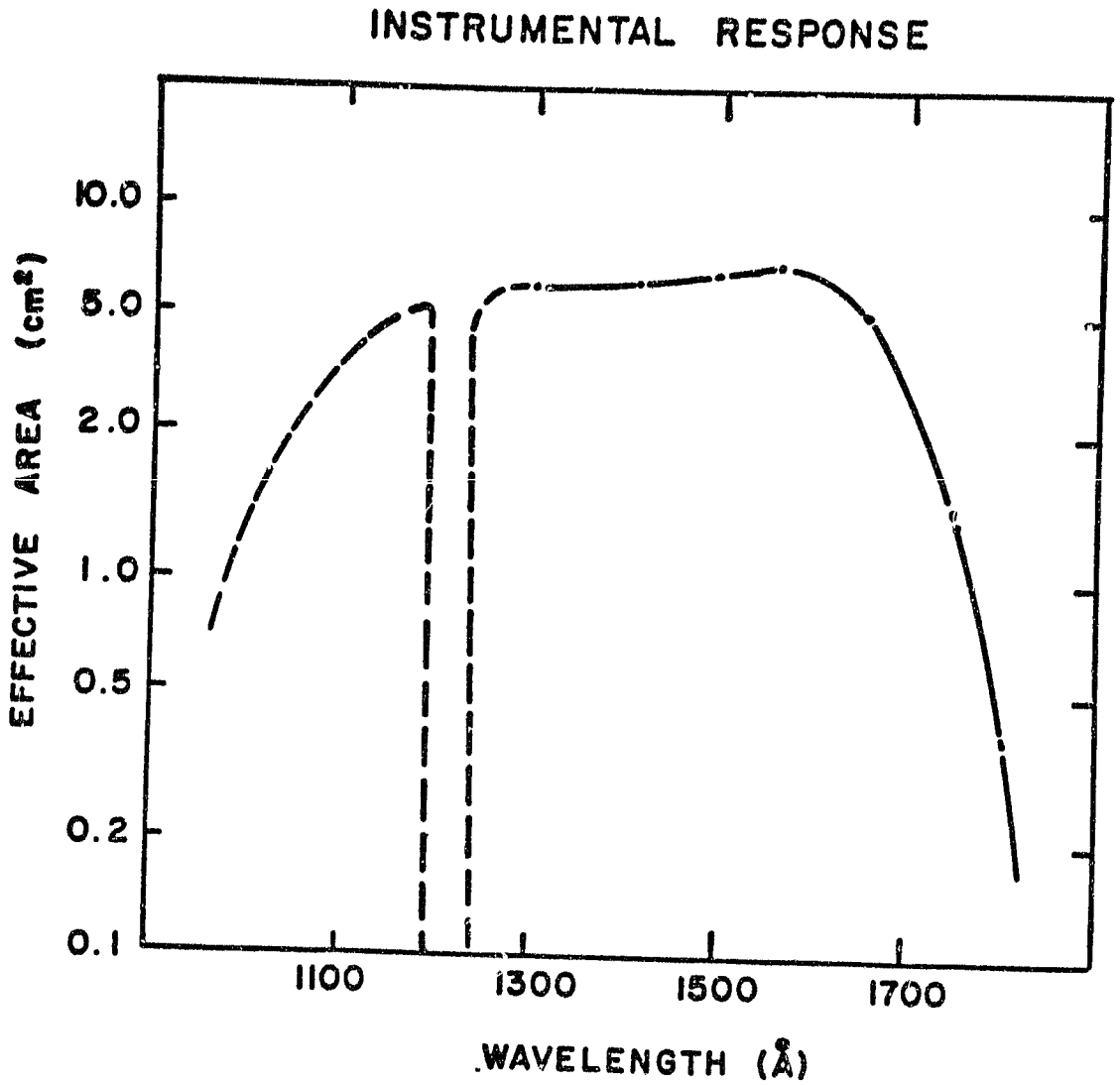
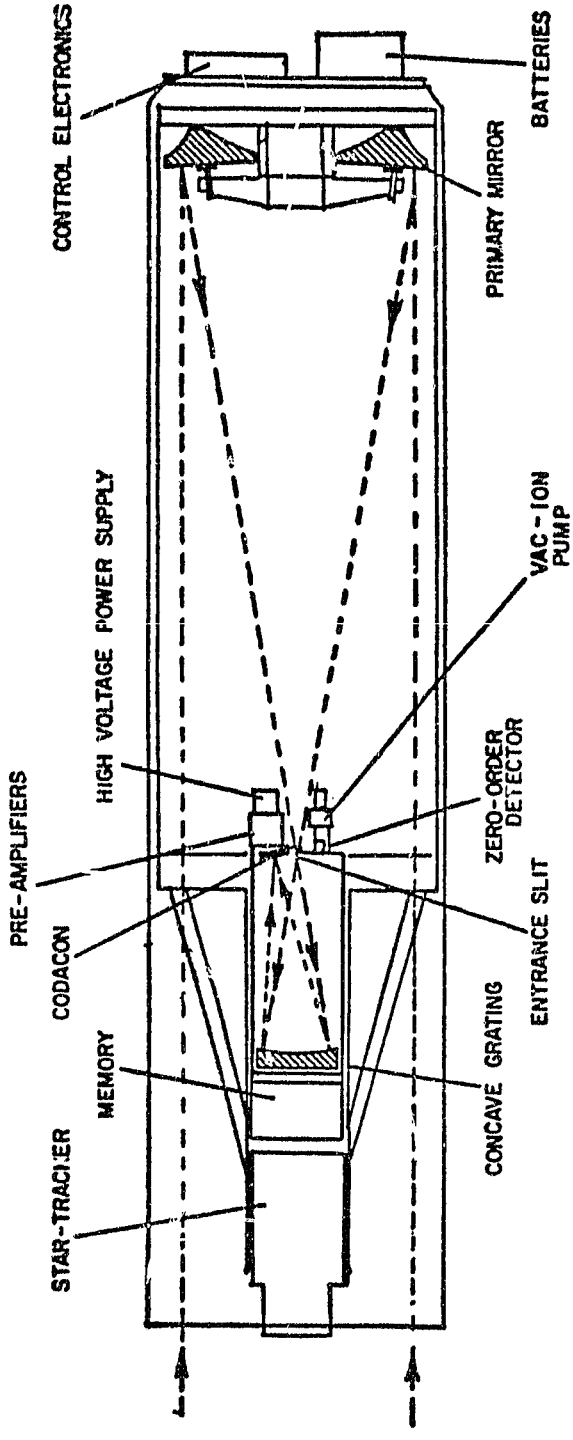


FIGURE 3



ROCKET-BORNE FAINT OBJECT SPECTROGRAPH

FIGURE 4

3. Rocket Flight 25.020

The above described spectrometer and telescope were assembled into a rocket payload as shown in figure 4. The payload was launched 11 March of 1977 on an Astrobee F rocket at WSMR.

The objective of the flight was to measure the ultraviolet flux from several stars and nebulae including the crab nebula in the 1050 to 1750 Å region with a 2.3 Å wavelength resolution. The temperature, density, and composition of the emitting material cou'd then be determined.

A STRAP III attitude control system in conjunction with a BBRC star tracker was used to orient the telescope in the direction of the various targets.

A standard PCM telemetry system was used to relay the information to ground.

The specific targets viewed were:

(1) α Car (used to update the roll gyro)
(2) β Gem (guide star)
(3) σ Gem (off set pointing)
(4) β Aur (guide star)
(5) IC2149 (offset pointing)
(6) ζ Tau (guide star)
(7) NGC 1952 (offset pointing)
(8) O'CMa (guide star)
(9) HD5089 (offset pointing)

All support systems functioned properly.

Due to high voltage breakdown in one of the cables, no data were obtained.

4. Rocket Flight 25.033

The recovery of 25.020 was very good. Only minor repairs were required to refurbish the payload to flight readiness condition.

The entire high voltage system was reviewed and modified to ensure that no high voltage breakdown problems would re-occur in the reflight.

The telescope and spectrometer were again flown on an Astrobee F rocket on 3/20/79.

The objectives were again to measure the ultraviolet flux from various stars and the crab nebula in the 1050 to 1750 Å region.

The entire support system remained as in 25.020.

The specific targets viewed were:

(1) α Car (used to update the roll gyro)
(2) α Aur
(3) ζ Tau (guide star)
(4) NGC 1952 (offset pointing)
(5) O'CMa

On this flight, more emphasis was given to obtaining data from the crab nebula than on 25.020.

Good data were obtained on the first three targets, but due to roll gyro error, the offset from ζ Tau to NGC 1952 was slightly in the wrong direction just grazing the crab nebula. Only data obtained in passing through the nebula edge were obtained. The intensity of the ultraviolet radiation was not as high as expected possibly inferring that the ultraviolet distribution from the nebula is not as expected but more from a point source.